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$$\therefore D = \frac{W}{w} \tan^4 \left(\frac{1}{2} \pi - \frac{1}{2} \phi \right), \text{ since } \sqrt{\frac{1 - \cos \theta}{1 + \cos \theta}} = \tan \frac{1}{2} \theta.$$

160. Proposed by F. P. MATZ.

Given the para-centric acceleration c^2/r^4 and the angular velocity $(n/m)\pi$ to determine the equation of the orbit.

Solution by G. B. M. ZERR, A. M., Ph. D., 4243 Girard Avenue, Philadelphia, Pa.

The acceleration along the radius vector is given by $d^2r/dt^2 - r(d\theta/dt)^2$.

$$\therefore d^2r/dt^2 - r(d\theta/dt)^2 = c^2/r^4.$$

The angular velocity is constant and equal to $\pi(n/m) = \beta = d\theta/dt$.

$$\therefore d^2r/dt^2 - r\beta^2 = c^2/r^4. \text{ But } dt = d\theta/\beta.$$

$$\therefore \beta^2 (d^2r/d\theta^2) - r\beta^2 = c^2/r^4. \quad \beta^2 [(dr/d\theta)^2 + r^2] - 2r^2\beta^2 = A - c^2/3r^3.$$

$$\therefore \beta^2 \left[\frac{1}{r^4} \left(\frac{dr}{d\theta} \right)^2 + \frac{1}{r^2} \right] - \frac{2\beta^2}{r^2} = \frac{A}{r^4} - \frac{c^2}{3r^3}.$$

$$\therefore \frac{\beta^2}{p^2} - \frac{2\beta^2}{r^2} = \frac{A}{r^4} - \frac{c^2}{3r^3}, \text{ since } \frac{1}{p^2} = \frac{1}{r^4} \left(\frac{dr}{d\theta} \right)^2 + \frac{1}{r^2}.$$

$$\therefore 3\pi^2 (n/m)^2 r^7 + p^2 c^2 = 3p^2 [Ar^3 + 2r^5 \pi^2 (n/m)^2] \text{ is the } r \text{ and } p \text{ equation.}$$

191. Proposed by DR. L. E. DICKSON, The University of Chicago.

Give the axiomatic principle of Physics which is equivalent to the theorem on the compound of two circles ("Graphical Methods in Trigonometry," MONTHLY, June-July, 1905, pp. 129-133).

Remarks by the PROPOSER.

On page 14 of the present volume, the principle is stated to be that of the parallelogram of forces (or of velocities). This answer is insufficient, as the compound of two circles relates to an infinitude of lines. A complete solution is as follows:

Two forces, represented in magnitude and direction by OP and OR have as their resultant the force represented by the diagonal OQ of the parallelogram $OPQR$. If we take the components of these forces along an arbitrary straight line OS , the sum of the components of OP and OR must equal the component of OQ . But in the figure (Vol. XII, top of p. 132), these components are the chords $O\pi$, $O\rho$, OS , respectively. Now $O\pi + O\rho = OS$ yields the point S called for by the definition of the compound of the circles on the diameters OP and OR .